

CHAPTER 4

DEMAND FOR REMEDIATION OF RCRA CORRECTIVE ACTION SITES

EPA estimates that over 6,000 facilities currently operate or have operated as treatment, storage, or disposal facilities (TSDFs) regulated under the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. UU6901-6922k). Prior to the creation of RCRA, facilities that treated, stored, or disposed of hazardous wastes often experienced releases of wastes into the environment. Much of that waste, which is similar to the hazardous wastes found at Superfund sites, was disposed of intentionally or unintentionally on the land. While not all RCRA facilities will require remediation, this program represents a substantial market for environmental site characterization and remediation services. EPA is authorized under RCRA and fully committed to oversee the correction of past contamination.

RCRA assigns the responsibility of corrective action to facility owners and operators and authorizes EPA to oversee corrective action. Unlike Superfund, RCRA responsibility is delegated to states. EPA and authorized states have completed initial assessments of potential environmental contamination at over 70 percent of RCRA facilities required by statute to address corrective action, but are still examining the extent of that contamination and the scope of remediation needed. Environmental contamination at many RCRA facilities is expected to be less severe than that at Superfund sites, but a number of RCRA facilities have corrective action problems that could equal or exceed those of many Superfund sites. EPA and states authorized by EPA to provide corrective action oversight expect remediation of existing contamination at RCRA facilities to extend into the next century.

4.1 Program Description

RCRA mandates several regulatory programs, but the largest is the waste management program, known as Subtitle C, which sets forth the comprehensive national requirements for

managing the treatment, storage, disposal, and recycling of solid and hazardous waste. Among other provisions, Subtitle C establishes a management system to control new hazardous waste from the time of its generation to its ultimate disposal (“cradle-to-grave”). Although its primary purpose is to prevent releases of wastes into the environment by minimizing waste generation and by creating reuse and recycling incentives, Subtitle C contains important requirements to address releases of contaminants from RCRA facilities that will influence the nature and amount of nationwide remediation activities.

Releases of contamination at RCRA facilities are addressed under the RCRA corrective action program, which is the primary focus of this chapter. Congress initially authorized EPA to promulgate requirements for monitoring and remediating only on-site releases to groundwater from hazardous waste management units, such as landfills. Later, with enactment of the 1984 Hazardous and Solid Waste Amendments (HSWA) of RCRA, Congress greatly expanded EPA’s corrective action authority to include releases to all environmental media from regulated solid waste management units (SWMUs) at TSDFs seeking a permit under Subtitle C. A solid waste management unit is a discernible unit in which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous wastes. This definition includes any area of a facility at which solid wastes have been routinely and systematically released. A release may include intentional or accidental spillage, leakage, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposal of hazardous waste into the environment. It also includes the abandonment or discarding of barrels, containers, and other closed receptacles containing hazardous wastes or hazardous constituents. Both the RCRA corrective action program for cleaning up past contamination and the hazardous waste management

program for preventing contamination are administered by EPA's Office of Solid Waste (OSW) and by states EPA has authorized to implement one or both programs.

In 1990 EPA prepared an overall strategy known as the RCRA Implementation Study (RIS). The strategy, which was designed to encourage corrective actions that produce the greatest near-term environmental benefits, contains two key components: to increase the use of interim actions that reduce imminent threats and prevent further spread of contamination, and to set national priorities for directing resources to the highest priority facilities.^[1]

EPA established procedures for implementing near-term corrective actions in the 1992 RCRA Stabilization Strategy.^[2] This strategy provides guidelines for eliminating or controlling sources of contamination and stabilizing contaminated media at RCRA facilities to prevent the further spread of contamination before long-term cleanups can be undertaken. These actions are similar to those undertaken in Superfund emergency response actions but place greater emphasis on substantial action to prevent the migration of contamination within and outside the facility boundary.

Because of the anticipated magnitude of remedial needs at RCRA facilities, EPA developed a computer-based system known as the RCRA National Corrective Action Prioritization System (NCAPS) to help establish priorities for corrective action activities.^[3] Among the factors considered in NCAPS are the history of hazardous waste release, likelihood of human and environmental exposure, and type and quantity of waste handled at the facility. NCAPS rankings are used by EPA and the states in conjunction with other considerations, such as enforcement history, to assign relative priorities among facilities subject to RCRA corrective action and allocate limited oversight resources. RCRA facilities are ranked high, medium, or low priority. Exhibit 4-1 presents the number of high-, mid-, and low-priority facilities that EPA and the states have ranked in each state and territory. In October 1995, there were approximately 1,540 high-priority facilities, 1,116 mid-priority facilities, and 1,175 low-priority facilities that had been ranked across the nation. High-priority facilities are the

main focus of EPA's program to stabilize contaminated media because of their perceived threat to human health and the environment.

4.1.1 Corrective Action Process

EPA first set forth the procedural and technical corrective action requirements in a 1990 proposed rule (Subpart S in the RCRA Part 264 regulations, July 27, 1990).^[4] In scope and level of detail, this 1990 proposed rule was analogous to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The 1990 proposed rule includes provisions for the consideration of cleanup standards, action levels, remedy selection, points of compliance, permitting and reporting procedures, and other technical and procedural issues. Although EPA has finalized only a few sections of the 1990 proposal, the bulk of the proposal has routinely been used as guidance during corrective actions. EPA published an Advanced Notice of Public Rulemaking (ANPRM) in May 1996.^[5] It stresses flexibility of the corrective action process by including less detailed oversight, more emphasis on results, and greater reliance on state programs. The ANPRM is functioning as guidance for the program until a final rule is promulgated.

The corrective action process, which is consistent with other Agency cleanup programs, generally includes the following events:

- 1) EPA or an EPA-authorized state conducts an initial assessment, termed a "RCRA Facility Assessment" (RFA) of the TSDF. The RFA involves identification and examination of a facility's SWMUs to determine if a release has occurred or if the potential for a release exists.
- 2) If the RFA reveals a release, the owner or operator of the facility may be required to conduct a "RCRA Facility Investigation" (RFI), which involves sampling and other efforts to determine the nature and extent of contamination and to fully characterize the site's geological and hydrological conditions. Concurrent with the RFI, the owner or operator may take near-term action (such as stabilization) to contain or remediate the contamination. Near-term corrective actions under the 1992 RCRA Stabilization Strategy may take place at any time.

Exhibit 4-1: Priority Ranking of RCRA Facilities in Corrective Action Workload Universe

STATE OR TERRITORY	RANKING				TOTAL FACILITIES	STATE OR TERRITORY	RANKING				TOTAL FACILITIES
	High	Mid	Low	Unranked			High	Mid	Low	Unranked	
Alabama	37	12	9	10	68	Nebraska	10	18	6	3	37
Alaska	10	8	3	1	22	Nevada	2	5	7	6	20
Arizona	9	11	40	24	84	New Jersey	63	52	50	61	226
Arkansas	14	13	7	19	53	New Mexico	11	5	4	4	24
California	102	106	212	134	554	New Hampshire	3	1	0	0	4
Colorado	28	32	48	51	159	New York	88	32	31	30	181
Connecticut	76	18	11	1	106	North Dakota	3	1	3	1	8
Delaware	10	0	3	2	15	North Carolina	30	25	17	18	90
DC	0	1	0	0	1	Ohio	89	69	78	16	252
Florida	44	30	9	11	94	Oklahoma	18	16	5	4	43
Georgia	45	24	21	32	122	Oregon	18	10	10	5	43
Guam	1	2	0	2	5	Pennsylvania	106	28	22	18	174
Hawaii	4	9	6	4	23	Puerto Rico	9	14	19	11	53
Idaho	4	5	6	2	17	Rhode Island	5	1	5	0	11
Illinois	61	49	87	5	202	South Carolina	35	13	9	11	68
Indiana	52	65	63	7	187	South Dakota	2	1	0	0	3
Iowa	14	65	16	1	96	Tennessee	28	9	12	21	70
Kansas	13	22	8	1	44	Texas	87	84	95	112	378
Kentucky	30	23	11	8	72	Trust Territories	1	0	0	1	2
Louisiana	37	15	11	11	74	Utah	12	5	10	7	34
Maine	10	7	0	4	21	Vermont	3	2	1	3	9
Maryland	23	7	8	3	41	Virgin Islands	1	0	0	0	1
Massachusetts	21	13	6	1	41	Virginia	48	9	12	23	92
Michigan	61	59	54	5	179	Washington	33	25	28	14	100
Minnesota	17	13	46	3	79	West Virginia	31	5	3	2	41
Mississippi	16	10	6	7	39	Wisconsin	24	17	35	1	77
Missouri	29	45	18	2	94	Wyoming	10	0	3	5	18
Montana	2	5	1	0	8	TOTALS	1,540	1,116	1,175	728	4,559

Source: U.S. EPA, Office of Solid Waste, RCRIS National Oversight Database, October 17, 1995.

3) The TSDF owner or operator is responsible for performing a "Corrective Measures Study" (CMS) to identify alternative measures for remediating contaminated areas when needed. Sometimes the CMS can be truncated or eliminated if the remedial alternative is obvious. The CMS also can be conducted concurrently with the RFI or after the investigation has been completed.

4) Upon approval of a remedy by the regulatory agency, the owner or operator may begin "Corrective Measures Implementation" (CMI), which includes designing, constructing, maintaining, and monitoring the remedial measures.

4.1.2 Corrective Action Implementation

Permitting and Enforcement

Corrective action may be implemented through the RCRA permit process, state or federal enforcement orders, or voluntarily. RCRA permits are required for all facilities that treat, store, or dispose of hazardous waste. Section 3004(u) of HSWA, which is directed specifically toward controlling releases from SWMUs, is the primary authority requiring corrective action at permitted TSDFs. It compels a facility owner or operator to address SWMU releases resulting from past disposal or recent contamination whenever seeking a RCRA permit. Additional authority is available under §3004(v) of HSWA to require a permitted TSDF to clean up contamination beyond the facility boundary. Thus, HSWA requires all hazardous waste facilities that obtain a RCRA permit after November 8, 1984, to take corrective action for any releases from past disposal or recent contamination from the facility, including all SWMU and off-site releases. For a TSDF operating under interim status rather than a RCRA permit, EPA can invoke HSWA §3008(h), which provides for enforcement orders, or state orders in an authorized state, to address any release of hazardous waste. The corrective action process for both permitting and enforcement orders is similar.

For actual or potential releases not originating from a SWMU, such as a one-time spill from a vehicle traveling across a facility, or for releases at TSDFs with permits that pre-date HSWA, EPA

may use its omnibus permitting authority pursuant to HSWA §3005(c)(3). This provision allows EPA to modify the facility's permit as necessary, requiring corrective action for any potential threat to human health or the environment. Also, HSWA §7003 gives EPA broad authority to seek injunctive relief in the appropriate U.S. District Court or to issue administrative corrective action orders for any waste from any source, including SWMUs, where the handling, storage, treatment, transportation, or disposal of solid or hazardous wastes may pose an imminent and substantial danger to public health or the environment.

To minimize the regulatory burden of RCRA corrective action without endangering public health or the environment, EPA has created exemptions and special permits. For example, EPA conditionally exempts from the Subtitle C hazardous waste regulations any waste samples collected solely for the purpose of monitoring or testing the characteristics or composition of RCRA facility contamination. Referred to as the Treatability Studies Sample Exemption Rule, which became final on February 18, 1994, the exemption places limits on the quantity of contaminated media that can be shipped, stored at a laboratory or testing facility, and treated there.^[6] The exemption rule also limits the amount of time the contaminated media may be retained for analysis or treatment.

Special permits and modifications are available to facilitate the development and application of innovative treatment technologies. For example, facility owners or operators may obtain RCRA research, development and demonstration (RD&D) permits for pilot-scale evaluations of treatment technologies. For on-site technology demonstrations at corrective action sites, EPA, in collaboration with the state, has the authority to modify a permit or enforcement order by granting a site-specific treatability variance for contaminated soils and debris when the facility cannot achieve the stringent technology-based treatment standards in the Land Disposal Restrictions (LDRs). Other permitting options are available through the Subpart X rule of RCRA, titled "Miscellaneous Units," which addresses hazardous waste management units that do not fit the current RCRA definition of container, tank, surface impoundment, pile, land treatment unit,

landfill, incinerator, boiler, industrial furnace, or underground injection well.^[7] For example, EPA and the Department of Defense (DOD) have worked together to dispose of munitions using the permitting options available for pilot-scale RD&D and the Subpart X rule.

State Authorization

States are the primary implementors of the RCRA program, including RCRA corrective action. As of December 1995, EPA has authorized 47 states, some territories, and the District of Columbia to manage their own base programs for waste management and prevention. Thirty-two of these states and territories also were authorized to implement RCRA corrective action. In addition, many other states have for some time been operating similar corrective action programs under their own authorities. Prior to granting a state full authorization for corrective action, EPA regional offices may develop grants and cooperative agreements under RCRA §3011 giving the state the lead for corrective action oversight at specific facilities. Although authorized state programs must meet the minimum federal requirements, a state may adopt regulations that are more stringent than the federal requirements.

4.2 Factors Affecting Demand for Cleanup

The factors that are likely to impact the extent of RCRA corrective actions relate to efforts to build more flexibility into the application of national standards to specific facilities.

Flexibility is needed primarily to facilitate the application of the Subtitle C hazardous waste management requirements to contaminated media that are the result of corrective action, and to expedite the time consuming and expensive permitting process.

Media containing hazardous waste from RCRA corrective actions are subject to the same Subtitle C regulations that apply to the management of newly-generated hazardous wastes. This requirement can, however, be counterproductive when applied to the cleanup of individual facilities because it can impose unnecessary costs and delays and limit cleanup options. For example, application of Subtitle C LDRs can, in

some situations, cause selection of corrective action remedies that are environmentally less desirable (e.g., containment) and sometimes more expensive than alternative remedies that otherwise would have been considered.

EPA and the states have sought to address contaminated media and permitting problems through several regulatory and policy directives, such as the LDR treatability variances for contaminated soils and the regulations for corrective action management units (CAMUs) and temporary units. However, the establishment and implementation of the CAMU rule have been difficult. Three rulemaking efforts will ultimately influence the extent and nature of corrective actions needed. These are described below:

- The final CAMU and temporary unit rule, published in 1993, was intended to result in more on-site treatment of greater volumes of remedial wastes at less cost and more expeditiously by providing EPA or authorized states with the authority to designate a site-specific area at a RCRA facility, called a CAMU, for the placement of remediation wastes without triggering LDR requirements.^[8] The rule also promoted innovative technologies that are appropriate for specific wastes and site characteristics.

Although the CAMU rule has received broad support from many affected organizations, it is not clear how much impact it is having. The Environmental Defense Fund is concerned that the rule may result in unacceptably lenient treatment requirements and has challenged the legal and policy basis for the rule. The litigation, which has been stayed pending publication of the final Hazardous Waste Identification Rule - Media (HWIR-Media), has slowed application of the rule. EPA expects that the HWIR-Media rule will largely obviate the need for the CAMU rule, and is planning to propose withdrawal of the CAMU regulations as part of the HWIR-Media proposal (which is discussed below). In the meantime, CAMUs may be used to support efficient and protective cleanups.

- EPA and the states, through a unique co-regulator effort, are developing a new

rulemaking called the *Hazardous Waste Identification Rule for Contaminated Media* (HWIR-Media). This proposed rule would modify the RCRA Subtitle C management requirements that apply to hazardous remediation wastes generated as a part of government-overseen cleanups (such as those under RCRA corrective action, Superfund, and other state programs). HWIR-Media was proposed on April 29, 1996.^[9] The proposal addressed a number of issues such as: exempting remediation wastes from certain Subtitle C management requirements; modifying land disposal restrictions; streamlining cleanup permit requirements (including exempting cleanup-only permits from the requirement for facility-wide corrective action); and streamlining state authorization. The rule would not address cleanup standards, remedy selection, or other “how clean is clean” issues. EPA expects that the final HWIR-Media rule will be an essential complement to the final RCRA Subpart S corrective action regulations. EPA and authorized states are committed to issuing regulations that reduce cleanup delays, achieve regulatory relief, and protect human health and the environment.

- As described in Section 4.1.1, EPA published an Advanced Notice of Public Rulemaking (ANPRM) in May 1996 which modifies technical and procedural corrective action requirements. The ANPRM is functioning as guidance for the program until a final rule is promulgated.
- As part of the President's initiative for reinventing environmental regulations, the Administration has, with input from interested parties, identified potential legislative amendments to provide appropriate relief for high-cost, low-benefit RCRA provisions. The administration believes any reforms to RCRA should proceed separate from CERCLA reauthorization.

A key area identified for potential legislative reform is the application of the RCRA Subtitle C hazardous waste management requirements to remediation wastes managed during cleanups overseen by regulatory agencies. EPA believes that an alternative framework

for remediation waste management could be developed that would protect human health and the environment while streamlining existing cleanups at RCRA, Superfund and Brownfield sites. This approach may stimulate a significant number of new cleanups, and significantly reduce costs for managing remediation wastes.

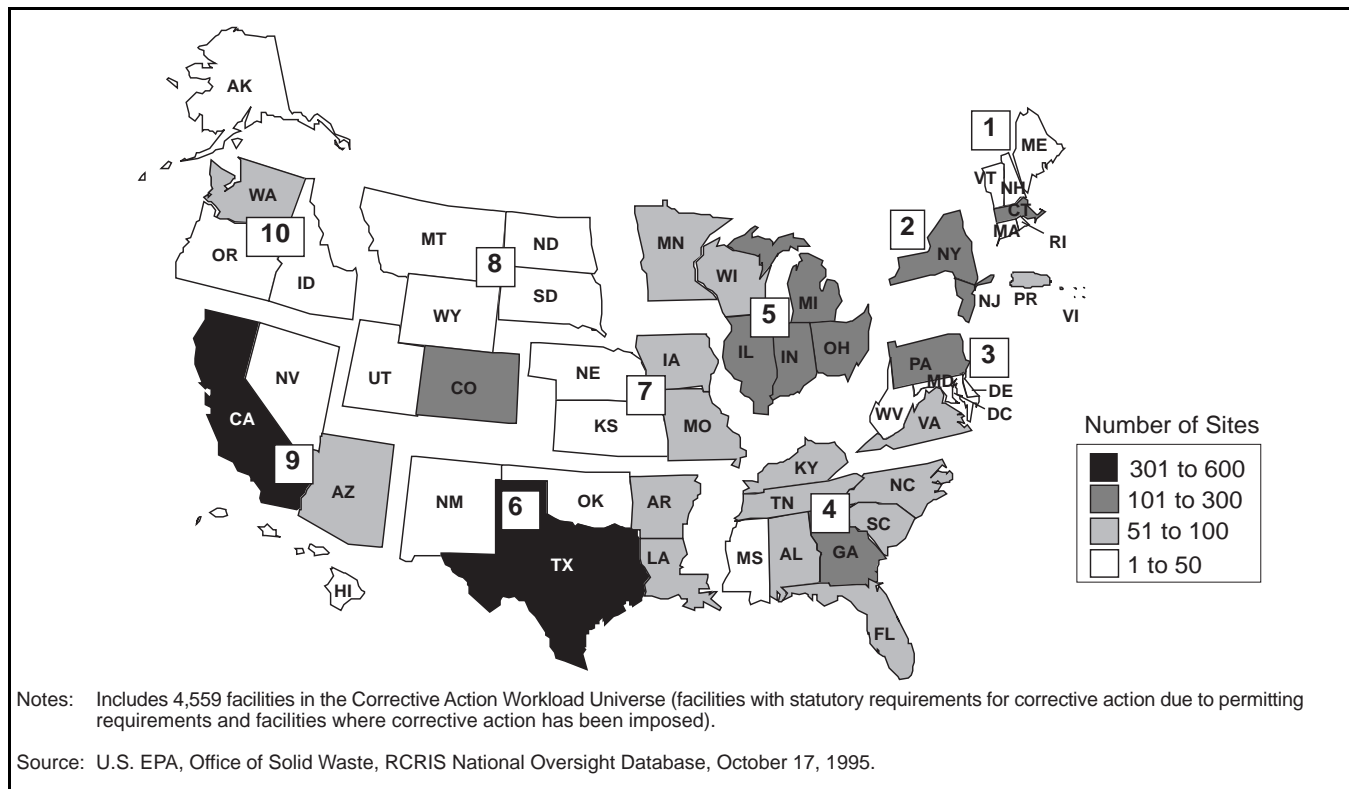
4.3 Number and Characteristics of Facilities

All facilities that are required to have RCRA permits and those where the Agency has discretionary authority to impose remediation are subject to corrective action requirements. However, not all of these facilities will actually require remediation, and until further study is conducted, the number of RCRA facilities that will require cleanup can only be estimated. Nevertheless, EPA's database, which includes the universe of potential corrective action facilities, called the corrective action workload universe, as well as two previous EPA studies, can be used to estimate the potential extent of corrective action in the future.

4.3.1 Number and Types of Facilities

As of October 17, 1995 EPA's Resource Conservation and Recovery Information System (RCRIS), a national program management and inventory system on hazardous waste handlers, contained information on 6,190 RCRA facilities where EPA has discretionary or statutory authority to impose corrective action when necessary.^[10] Of these, the corrective action workload universe contains 4,559 facilities that are required to address corrective action because of permitting requirements or because they already are involved in some phase of corrective action. Approximately seven percent of them are federal facilities. Facilities excluded from this universe are clean-closed facilities, facilities that have not notified EPA or are late in notifying EPA that they are handling hazardous wastes, and facilities that have converted to less than 90-day storage of hazardous waste. Technically, however, all of these facilities are subject to RCRA permit requirements and corrective action. Exhibit 4-2 shows the distribution of RCRA facilities in the corrective action workload universe among the states, and Exhibit 4-1 (above) contains the current numbers of facilities in this universe in

**Exhibit 4-2: Location of RCRA Corrective Action
Facilities in EPA's 10 Regions**



each state or territory. Approximately 1,540 of the facilities in the workload universe have been ranked as high-priority sites under the RCRA National Corrective Action Prioritization System. Exhibit 4-3 shows the states in which high-priority sites are located. Most states have under 31 high-priority facilities, nine states have over 60, and only Pennsylvania and California each have over 100.

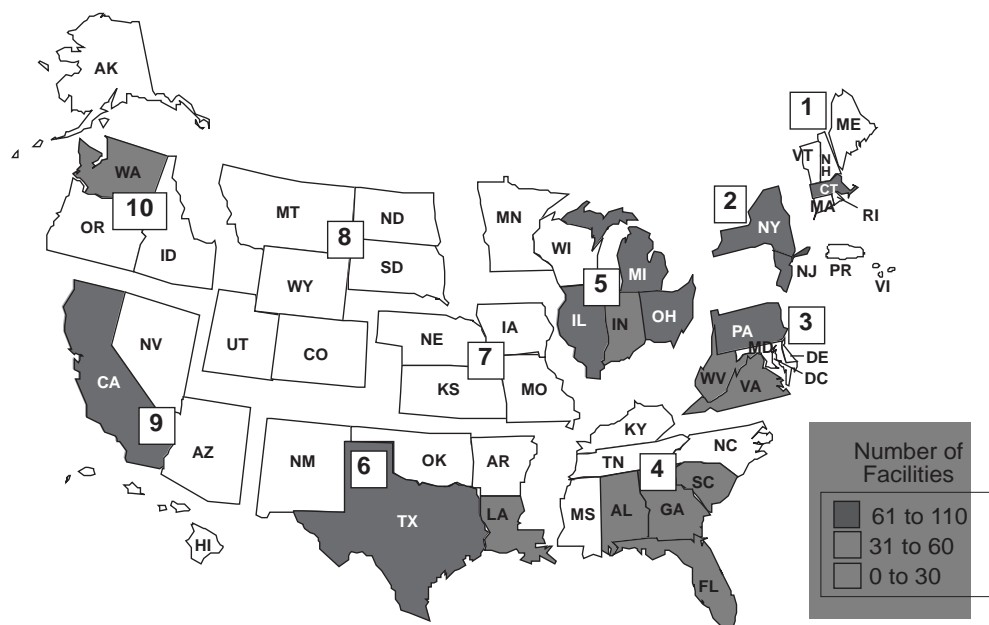
A RCRA facility may operate one or more types of hazardous waste management processes, which may lend insight into the nature of the cleanup needed. RCRA facility processes include land disposal such as landfills, land treatment units, surface impoundments, waste piles, and underground injection wells; treatment or storage in tanks or containers; and incineration. A waste pile is any non-containerized accumulation of solid, nonflowing hazardous waste that is used for treatment or storage. The definitions of other processes, including container, tank, surface impoundment, landfill, incinerator, and injection well, may be found in 40 CFR §260.10.^[11] Exhibit 4-4 presents the major processes operated

now or in the past by permitted, closing, or closed facilities. Because each facility may be performing more than one process, the total number of processes exceeds the number of facilities. Storage and treatment in tanks or containers account for 71 percent of the processes reported, followed by land disposal at 26 percent, and incineration at three percent.

The Agency has developed two separate estimates of the number of facilities likely to require corrective action. These estimates, which were developed for different purposes, range from 2,600 to 3,700 facilities that are expected to eventually require investigation and remediation under the RCRA corrective action program.

The 1990 RCRA Implementation Study contained an estimate of 3,700 RCRA facilities that would likely require corrective action. In preparing this estimate, EPA projected that of approximately 4,700 RCRA land disposal, incinerator, and treatment and storage facilities in the United States at that time, about 80 percent, or 3,700 facilities, with about 64,000 SWMUs may need

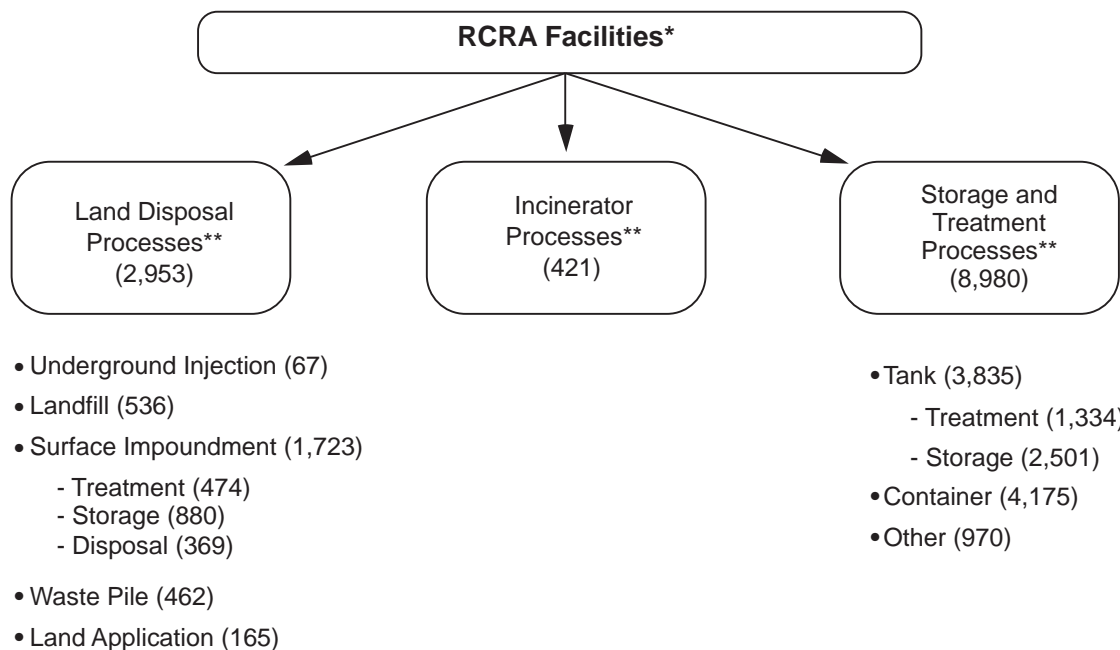
Exhibit 4-3: Location of 1,540 High-Priority RCRA Corrective Action Facilities in EPA's 10 Regions



Notes: Based on 4,559 facilities in the Corrective Action Workload Universe (facilities with statutory requirements for corrective action due to permitting requirements and facilities where corrective action has been imposed).

Source: U.S. EPA, Office of Solid Waste, RCRIS National Oversight Database, October 17, 1995.

Exhibit 4-4: Major Processes for Managing Waste at RCRA Facilities



Notes: *Includes all 6,190 permitting, closing, and closed facilities in the Progress Universe of RCRIS.
 **More than one type of process may apply at a single facility.

Source: U.S. EPA, Office of Solid Waste, RCRIS National Oversight Database, October 17, 1995.

additional investigation or corrective action.^[11] About 3,000 facilities still needed a RFA to determine whether there were releases.

A 1993 corrective action regulatory impact analysis estimated that 2,600 facilities with 15,000 SWMUs would require corrective action for past, current, or future environmental releases under the 1990 proposed Subpart S rule.^[12] The 15,000 SWMUs estimated to require corrective action include about half of the facilities with landfills, 45 percent of facilities with surface impoundments, and 10 percent of facilities with tanks. EPA developed these estimates by analyzing random samples of federal and nonfederal facilities and selecting a final sample of 79, comprised of nine federal and 70 non-federal facilities.

4.3.2 Characteristics and Quantities of Hazardous Waste

Information on the types of contaminants and contaminated media found at corrective action sites can indicate what kinds of cleanup technologies will be needed. Although the aforementioned EPA databases contain preliminary information, data are not available to thoroughly characterize the constituents and waste volumes that will require cleanup at all sites. Most facilities subject to corrective action have not undergone a RFI, which would characterize the extent of on- and off-site environmental contamination.

Two separate studies provide an indication of the nature of contaminants at RCRA corrective action sites. In one study, EPA's Technology Innovation Office obtained information on a total of 275 TSDFs from EPA's regional offices in 1992 and 1993 for the purpose of identifying relationships between site characteristics and the use of innovative technologies at RCRA corrective action sites.^[13] At the 214 TSDFs where contamination data were available, halogenated volatile organic compounds (VOCs), the most prevalent of all contaminant groups reported, were present at 60 percent of the TSDFs, followed by heavy metals at 46 percent, and nonhalogenated VOCs at 32 percent. Exhibit 4-5 presents the frequency of the most common contaminant groups. Groundwater (82 percent) and soil (61 percent) were the most commonly reported contaminated media at the

256 TSDFs for which media data were available (Exhibit 4-6). Many of the study facilities had both soil and groundwater contamination.

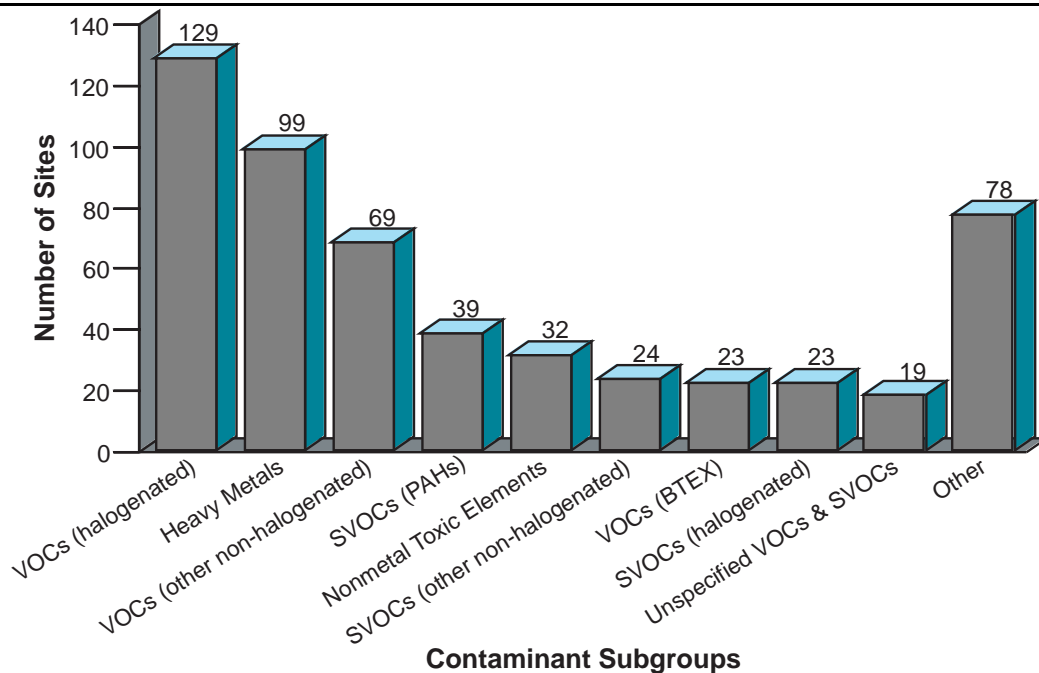
The second study is the regulatory impact analysis (RIA) developed to support the 1993 corrective action rule. This study utilized information on a sample of 79 TSDFs to estimate contamination that is likely to be present in soil or groundwater at concentration levels that would require action.^[12] For some facilities, EPA used a fate and transport model to predict the extent of current and future contamination. EPA used a long-term modeling approach to simulate contaminant concentrations over 128 years, from 1992 to 2119. EPA attempted to capture some of the uncertainty associated with potential human exposures and risk assessment in these long-term projections.

Of the 2,600 TSDFs estimated to require corrective action in the RIA, about 2,100 (80 percent) might have significant releases to on-site groundwater, and at about half of these facilities the size of these releases will be one acre or less. Also, about 780 (30 percent) of the 2,600 TSDFs probably will have significant off-site groundwater contamination. Exhibit 4-7 displays the projected extent of on-site groundwater contamination over the modeling period for the 2,600 facilities.

The predominant contaminants expected in groundwater are presented, along with their concentration ranges, in Exhibit 4-8. The concentration range for each constituent in the table is expressed relative to EPA's action levels, which are concentrations that are high enough to trigger concern. The action levels referenced in Exhibits 4-8 and 4-9 are directly or indirectly derived from those used by the Agency in the 1990 proposed corrective action rule by applying assumptions given in that rule.^[4] In the proposed rule, the Agency borrowed action levels from existing programs, such as the Safe Drinking Water Act's maximum contaminant levels.

For the RIA, EPA also estimated releases of contaminants to soil at TSDFs that may require corrective action. EPA used soil sampling data, information on SWMU size, and expert judgment to develop the estimates. Exhibit 4-10 presents the percent of facilities projected to have varying

Exhibit 4-5: Frequency of Most Common Contaminant Groups at a Sample of RCRA Corrective Action Sites

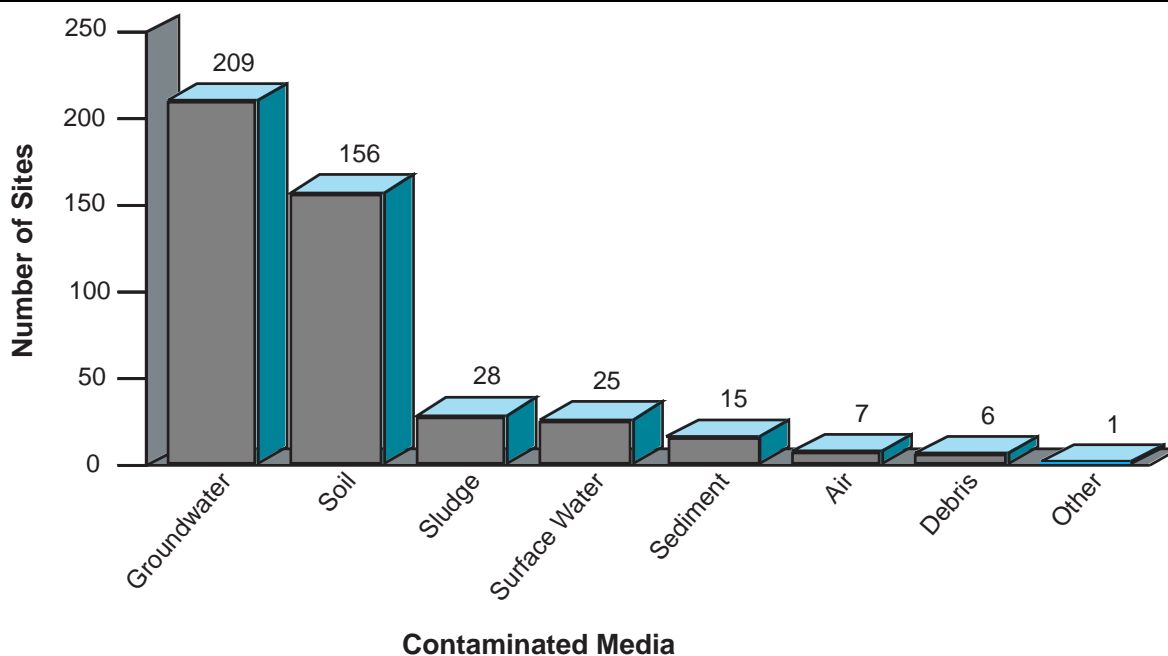


Notes: Total sites = 214

PAH = Polynuclear aromatic hydrocarbons; BTEX = Benzene, toluene, ethylbenzene, and xylene

Source: U.S. EPA, Office of Solid Waste and Emergency Response, Technology Innovation Office, *Analysis of Facility Corrective Action Data*, January 1994.

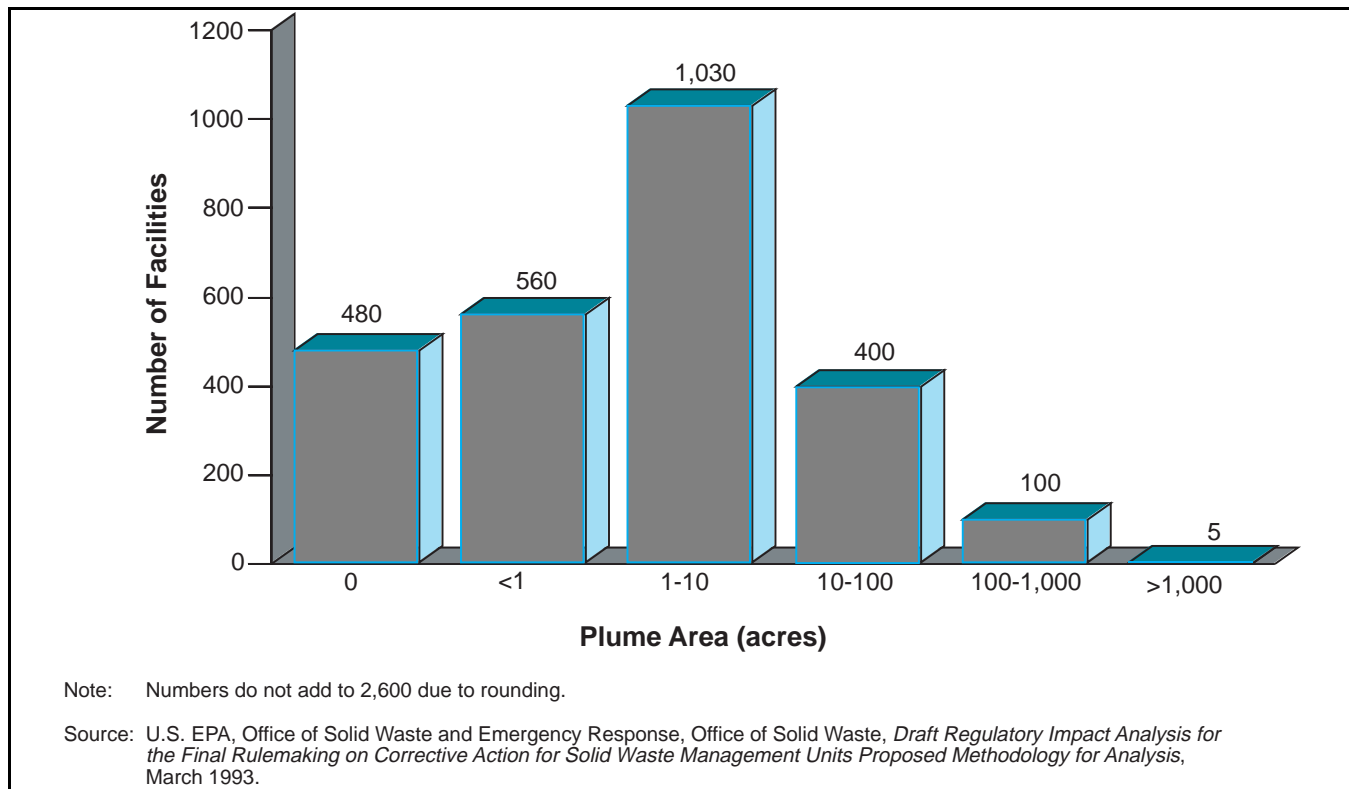
Exhibit 4-6: Frequency of Contaminated Media at a Sample Corrective Action Sites



Note: Total sites = 256

Source: U.S. EPA, Office of Solid Waste and Emergency Response, Technology Innovation Office, *Analysis of Facility Corrective Action Data*, January 1994.

Exhibit 4-7: Projected Extent of Baseline On-Site Groundwater Contamination at 2,600 RCRA Corrective Action Facilities



quantities of contaminated soil on-site, above EPA action levels. On-site soil contaminant concentrations above EPA action levels are expected to occur at about 1,700 (68 percent) of the 2,600 TSDFs estimated to require corrective action. About 500 of the facilities (19 percent) are estimated to have between 60,000 and 10 million cubic feet of contaminated soil per facility, and 1,240 (48 percent) of the facilities are expected to have under 60,000 cubic feet. 830 (32 percent) of the facilities have no soil contamination. The predominant constituents above action levels in on-site soil are presented in Exhibit 4-9 along with their concentration ranges relative to EPA's action levels.

Using a fate and transport model, EPA projected off-site soil contamination in excess of action levels at about 200 (8 percent) of the 2,600 facilities likely to require corrective action. Other media expected to be contaminated above action levels include off-site surface waters at about 140 (5 percent) sites and air at less than one percent of the 2,600 facilities.

4.4 Estimated Cleanup Costs

According to estimates derived from the 1993 corrective action RIA,^[12] it will cost \$38.8 billion (undiscounted in 1996 dollars), or \$14.9 million per facility, to implement the 1990 proposed Subpart S corrective action program. Approximately 89 percent of this amount will be incurred by privately-owned facilities and the remaining 11 percent by federal facilities. The estimated corrective action costs included in the RIA do not include those of the very large DOD and DOE facilities, although it includes some smaller ones. Roughly half of the total cost of corrective action would be incurred by slightly more than 10 percent of the facilities expected to incur costs.

(The cost estimate published in the RIA, \$18.7 billion, is the present value of the above figure, calculated using a seven percent discount rate and in 1992 dollars. The adjustment from 1992 to 1996 dollars is based on the Department of Labor's Consumer Price Index for all commodities). These estimates may not include some long-term monitoring and administrative

**Exhibit 4-8: Predominant Constituents Projected Above Action Levels
in Groundwater at 2,100 RCRA Corrective Action Facilities**

Constituent	Percent of Facilities with Constituent	Ratio of Concentration Levels to Action Levels (mg/l)	
		Minimum Ratio Estimated	Maximum Ratio Estimated
Chromium	47	1	8,330
Benzene	30	1	488,680
Methylene Chloride	23	1	10,830
Arsenic	20	1	7,760
Lead	20	3	3,550
Tetrachloroethylene	18	1	108,210
Trichloroethylene	17	3	730
Naphthalene	14	20	349,640
1,1,2-Trichloroethane	11	2	11,000
1,1-Dichloroethylene	10	30	640
Methyl Chloroform	10	15	190
1,1-Dichloroethane	10	2	20
1,2-Dichloroethylene	10	1	6
Toluene	10	2	2,440
Cadmium	7	3	91,240
Nickel	7	3	1,570
Aniline	3	160	900
Selenium	3	6	2,060
Xylenes	3	1	4

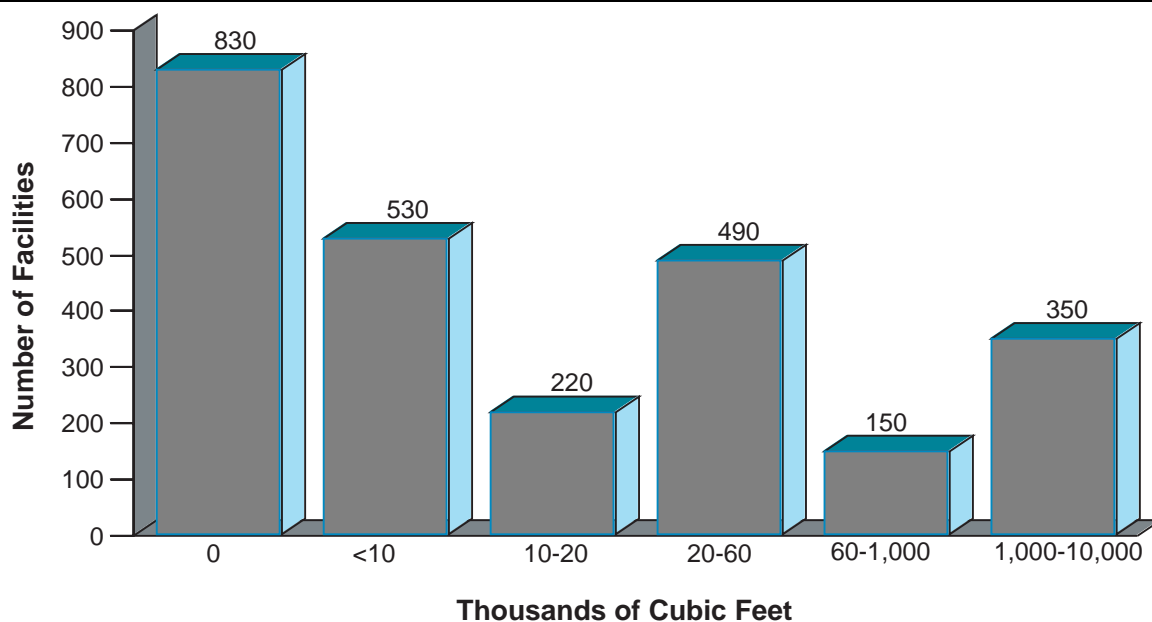
Source: Adapted from *Draft Regulatory Impact Analysis for the Final Rulemaking on Corrective Action for Solid Waste Management Units Proposed Methodology for Analysis*, March 1993.

**Exhibit 4-9: Predominant Constituents Projected to be Above Action Levels
in Soil at 1,700 RCRA Corrective Action Facilities**

Constituent	Percent of Facilities with Constituent	Ratio of Concentration Levels to Action Levels (mg/l)	
		Minimum Ratio Estimated	Maximum Ratio Estimated
Tetrachloroethylene	26	1	100
Trichloroethylene	16	1	10
Chromium	13	0.01	10
Arsenic	13	0.1	100

Source: Adapted from *Draft Regulatory Impact Analysis for the Final Rulemaking on Corrective Action for Solid Waste Management Units Proposed Methodology for Analysis*, March 1993.

Exhibit 4-10: Projected Extent of Baseline On-Site Soil Contamination at 2,600 RCRA Corrective Action Facilities



Note: Numbers do not add to 2,600 due to rounding.

Source: U.S. EPA, Office of Solid Waste and Emergency Response, Office of Solid Waste, *Draft Regulatory Impact Analysis for the Final Rulemaking on Corrective Action for Solid Waste Management Units Proposed Methodology for Analysis*, March 1993.

costs, which together would be less than ten percent of total costs.

EPA projects that both overall and near-term program costs are likely to be much lower than those estimated in the RIA. Over the past few years, implementation of the corrective action program has shifted toward more risk-based cleanups, largely as a result of the development and publication of the May 1, 1996 Advanced Notice of Proposed Rulemaking (ANPRM) for Subpart S.^[5] This shift represents a different approach to remediation than that which was modeled in the 1993 RIA. In addition, the near-term costs of the program are likely to be reduced due to the ANPRM's emphasis on stabilization remedies rather than permanent remedies in the short-term.

4.5 Market Entry Considerations

The responsibility for RCRA corrective action at individual facilities lies with the owners and operators who contract directly with commercial vendors for services. RCRA requires that owners

and operators be aware of technologies that may be used and those that are subject to restrictions or are banned. Because there is no centralized source of RCRA facility information, vendors interested in the corrective action market will have to contact specific owners or operators to obtain information on an individual facility's corrective action requirements, waste characteristics, and cleanup needs. Many state hazardous waste agencies, and to a lesser degree EPA regional offices, have additional information about the corrective action needs of facilities in their areas.

4.6 Remedial Technologies

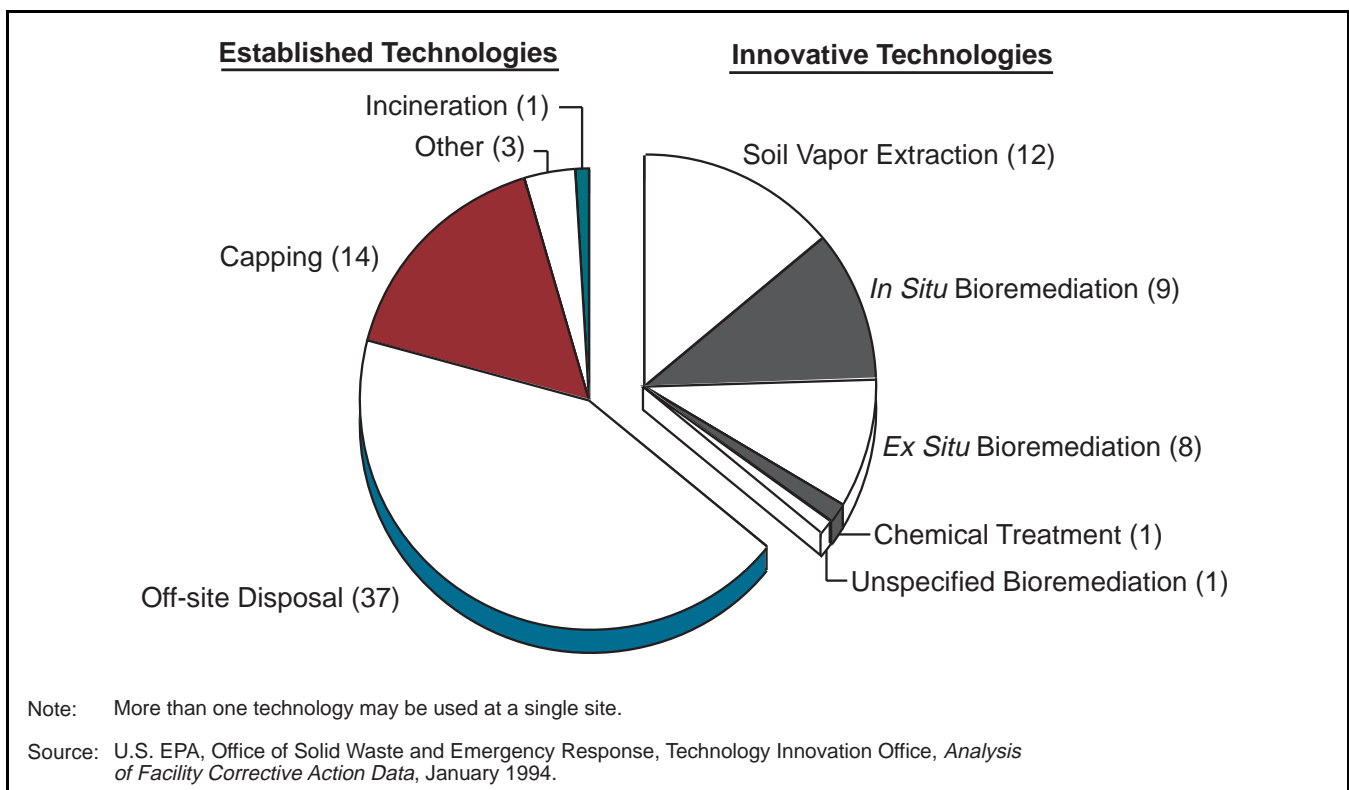
Data on technology applications for 186 TSDFs are available from an EPA study completed in 1994.^[13] Of 133 facilities treating groundwater, pumping and treating was selected for 116 sites (87 percent) and innovative technologies were selected for nine sites (7 percent). The innovative technologies include *in situ* bioremediation for four sites, *ex situ* bioremediation for two sites, and unspecified bioremediation, thermal

desorption, and chemical treatment for one site each. Of 86 sites requiring soil treatment, established technologies were selected for 55 sites (64 percent) including capping and off-site disposal for 51 sites, incineration for one site, and others for three sites. Innovative technologies, such as soil vapor extraction (SVE), bioremediation, and chemical treatment were selected for 31 (39 percent) of the sites requiring soil treatment. Of the innovative technologies selected for soil, most are likely to be used to remediate halogenated and nonhalogenated VOCs in soil. Exhibit 4-11 summarizes specific

innovative and established technologies applied or likely to be applied to soil contamination at the 86 sites requiring soil treatment.

Information on technology applications also was found in the Statements of Basis for 50 sites collected by EPA. Based on these unpublished documents, innovative source control technologies (SVE and thermal desorption) were chosen seven times to treat VOCs in soil. Pump-and-treat was the most frequently selected remedy to treat groundwater.

**Exhibit 4-11: Remedies Selected for Soil
at 86 RCRA Corrective Action Facilities**



4.7 References

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7. U.S. Environmental Protection Agency, *Hazardous Waste Miscellaneous Units, Applicable to Owners and Operators; Final Rule* (52 *Federal Register*, p. 46946), December 10, 1987.
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9. U.S. Environmental Protection Agency, *Hazardous Waste Identification Rule; Proposed Rule*, 61 *Federal Register*, p. 18780, April 29, 1996.
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12. U.S. Environmental Protection Agency, Office of Solid Waste, *Draft Regulatory Impact Analysis for the Final Rulemaking on Corrective Action for Solid Waste Management Units Proposed Methodology for Analysis*, March 1993.
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